

***Report of the January 31 - February 3, 1995 Meeting of the
CEBAF Program Advisory Committee***

– PAC9 –



The Continuous Electron Beam Accelerator Facility

The Continuous Electron Beam Accelerator Facility (CEBAF) is a national physics user facility managed by the Southeastern Universities Research Association (SURA), Inc., for the U.S. Department of Energy (DOE) under contract DE-AC05-84ER40150.

For more information or copies of this report contact:

CEBAF User Liaison Office, MS 12B

12000 Jefferson Avenue

Newport News, VA 23606

Phone: (804) 249-7586

Fax: (804) 249-7398

E-mail: users@cebaf.gov

DISCLAIMER

This report was prepared as an account of work sponsored by the United States Government. Neither the United States, nor the United States Department of Energy, nor any of their employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, mark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

March 6, 1995

Dear Members of the CEBAF User Group,

After initiating operations in Hall C with beams up to 2.1 GeV earlier this year, we are now moving toward 4.0 GeV operation this month. The Hall C User community and staff are putting their experimental equipment on-line on time to meet the Spring and Summer 1995 goals. Installation activities for Halls A and B are on target. As part of ensuring an excellent physics program, the January 31 - February 3, 1995 Program Advisory Committee (PAC9) heard details on the progress of the Accelerator and all three Halls, discussed the initial plan for Hall A commissioning, and considered extensions to experiments, new proposals and letters-of-intent, and experiment updates.

Attached is the *Report of the January 31 - February 3, 1995 Meeting of the CEBAF Program Advisory Committee*. I want to thank John Cameron and the members of the PAC for their thoughtful deliberations and for their care in the preparation of this report.

To keep the schedules for installation of equipment in Halls A and B and to keep the schedule for initial operations in Hall C, as well as to implement the PAC's suggestions in the attached report, the PAC meeting originally scheduled for June 1995 will be skipped and the next PAC meeting (PAC10) will be January 1996. The planned two PAC meetings per year as discussed with the User Group Board of Directors will occur as installation and commissioning efforts are completed.

I wish to thank you the Users for your efforts on the proposals, extensions, letters-of-intent, and updates. I particularly wish to express my thanks for your efforts in bringing the experimental equipment on-line for the beginning of CEBAF's exciting physics program.

Sincerely,

Hermann Grunder
Director

Report of the January 31 - February 3, 1995 Meeting of the CEBAF Program Advisory Committee

Introduction

The CEBAF Program Advisory Committee held its ninth meeting on January 31-February 3, 1995 in CEBAF Center. The PAC9 membership is given in Appendix B. In response to a charge (Appendix A) from the Director, Dr. Hermann Gruner, the committee reviewed and made recommendations on twenty-one new proposals, plus three proposals which had previously been conditionally approved or deferred. The committee also provided brief comments on eight letters-of-intent and extensions to six experiments which requested additional running time with 6 GeV beam. Updates for many experiments previously accepted for running in Hall B were submitted. Unfortunately, due to the imposition of Town meetings associated with the NSAC Long Range Plan, it was necessary to shorten the PAC meeting and postpone the rating of Hall B experiments until PAC 10.

The PAC meeting started with an informal report on progress in the commissioning of the Accelerator and the Hall C experimental equipment. The committee was most impressed with the substantial progress which was presented on both, and wishes to record its congratulations to all involved in attaining these successes. A presentation on a preliminary plan for early running in Hall A also was given.

General Comments on Proposals and Presentations

The overall quality of proposals presented for review continues to be good. However, the PAC commented that several proposals suffered from a tendency to be too all inclusive and that these would have benefitted from a more focused approach to the major physics question being addressed. Again, all spokespersons adhered amazingly accurately to the time schedule for presentations—a trait which allowed the PAC to complete its reviews in a reasonable period.

Concerns and General Recommendations

The following concerns and recommendations were discussed by the PAC:

1. As mentioned above, the PAC heard a proposal for the commissioning procedure for Hall A. The committee agreed with the general outline for this process, but had a number of concerns. The first was that care must be taken not to start an excessive number of lower priority experiments. This has two potentially negative effects: it can delay the most important work needed to get high priority experiments on the floor, and it can lead to a commitment to finishing the lower priority experiments once they are started. The second major concern was the absolute necessity of having a suitable hydrogen target available at this early commissioning stage. The present situation in Hall C indicates that credible measurements can only be performed on nuclear targets after calibrations have been carried out using known reaction cross sections for hydrogen. In the Hall A case, it may be advisable to have a lower power target with more than one loop which would be sufficient for initial measurements that will use intensities up to 25 microamps. This target could later be augmented with the full 1 kW-rated target planned for Hall A.
2. While the committee was impressed with progress on all fronts, it wishes to recommend most firmly that personnel associated with equipment yet to be completed work diligently to get to the point where experiments can be performed as quickly as possible. In this context there is particular concern regarding the great number of person-hours that must go into Hall B installation. It is difficult to concentrate on the timely completion of the detector while

simultaneously developing the steady stream of well-organized proposals that the PAC has been receiving. The PAC is also aware that a similar situation is developing in Hall A. The PAC expresses a concern that the Hall A and Hall B collaborations should be extremely careful in committing further resources to new proposals until these Halls are in operation. The PAC recommends that the next meeting of the committee be held about the end of 1995 or early 1996.

3. The two letters-of-intent that would utilize high energy back-scattered polarized photons were seen to have considerable potential. These are encouraging signs that a competitive physics program will be formulated for the proposed facility.
4. The PAC continues to express concern that some physicists' names appear on far too many proposals. The committee recommends that a review of the overall commitment of individuals be performed. Without such information, it is not possible to gauge whether the manpower is in place to complete experiments and to publish results in an expedient manner. Thus, no comments on the manpower section have been made for proposals considered at PAC 9.

The reports and PAC recommendations for each of the proposals reviewed are given in Appendix D. The following tables summarize results from PACs 4-9.

Totals for PACs 4-9

	Experiments Recommended for Approval	Additional Experiments Recommended for Conditional Approval	Total
Experiments	76	16	92
Authors	542	48	590
Institutions	114	6	120
Countries	20		20

Totals of Approved Experiments by Physics Topic for PACs 4-9

Topic	Number	Hall A	Hall B	Hall C
Nucleon and Meson Form Factors and Sum Rules	10	3	3	4
Few Body Nuclear Properties	14	7	4	3
Properties of Nuclei	15	4	8	3
N^* and Meson Properties	25	3	20	2
Strange Quarks	12	2	7	3
Total	76	19	42	15

A listing of experiments recommended for approval by physics topic for PACs 4-9 is attached to this report. Summaries of experiments recommended for approval by PACs 4-7 are available from the User Liaison Office in the report: *CEBAF Experiment Summaries, January 1994*. A new version of the summaries, which will include PAC8 and PAC9 results, will be available in the Spring of 1995. The new version will also be available via the World Wide Web along with reports from PACs 4-9 under: <http://www.cebaf.gov>.

John Cameron

Chair, CEBAF Program Advisory Committee

Date: _____

Appendices

- A. Charge to PAC9
- B. PAC9 Membership
- C. PAC9 Recommendations
- D. Individual Reports for PAC9 Proposals
- E. Individual Reports for PAC9 Letters-of-Intent
- F. CEBAF Approved Experiments, PACs 4-9, Group by Physics Category

Appendix A

Charge to PAC9

Following is the charge to the PAC from CEBAF Director, Hermann Gruner:

CEBAF requests PAC9 to:

- 1) review extensions, proposals and updates and provide advice on,
 - A) the scientific merit, technical feasibility, and manpower requirements,
 - B) a recommendation for placement into one of four classes:
 - a) approval,
 - b) conditional approval status pending clarification of special issues,
 - c) deferral, or
 - d) rejection,
- 2) provide a scientific rating for all approved extensions, proposals and updates,
- 3) make a beam time allocation for those experiments utilizing standard operating procedures,
- 4) provide comments on letters-of-intent, and
- 5) comment on the Hall A draft start-up plan.

Appendix B

PAC9 Membership

B-1

JOHN CAMERON (Chair)
Indiana University Cyclotron Facility
2401 Milo B. Sampson Lane
Bloomington, IN 47405
Ph/Fax: (812) 855-9407/855-6645
Cameron@gremlin.iucf.indiana.edu

DOUG BECK
University of Illinois
Nuclear Physics Laboratory
23 Stadium Drive
Champaign, IL 61820
Ph/Fax: (217) 244-7994/333-1215
Beck@uinpla.npl.uiuc.edu

DAVID CASSEL
Cornell University,
F. R. Newman Lab of Nuclear Studies
Ithaca, NY 14853
Ph/FAX: (607) 255-3915/254-4552
dgc@lns62.lns.cornell.edu

DIETER DRECHSEL
Insitut Fuer Kernphysik, Universitaet Mainz
J.-Joachim-Becher Weg 45, Postfach 39 80
6500 Mainz, Germany
Ph/Fax: 011-49-6131-39-3695/39-2964
Drechsel@vkpmzd.kph.uni-mainz.de

BRAD FILIPPONE
California Institute of Technology
Kellogg Radiation Laboratory
Pasadena, CA 91125
Ph/Fax: (818) 395-4517/564-8708
brad@erin.caltech.edu

WICK HAXTON
Department of Physics - FM 15
University of Washington
Seattle, WA 98195
Ph/Fax: (206) 685-2397/0635
Haxton@phys.washington.edu

BARRY HOLSTEIN
Department of Physics & Astronomy
University of Massachusetts
1126 Lederie Graduate Research Center Towers
Amherst, MA 01003
Ph/Fax: (413) 545-2545/545-0648
Holstein@phast.umass.edu

ROY HOLT
Department of Physics
Loomis Laboratory of Physics
1110 W. Green St.
University of Illinois
Urbana, IL 61801-3080
Ph/Fax: (217) 244-6039/333-1215
Holt@uinpla.npl.uiuc.edu

PETER DE WITT HUBERTS
NIKHEF-K
P.O. Box 41882
1009 DB Amsterdam, The Netherlands
Ph/Fax: 31-20-592-2163/2165
marijke@paramount.nikhefk.nikhef.nl

JEAN-MARC LAGET
DAPNIA/SPhN
Orme des Merisiers
CEN Saclay
91191 Gif-Sur-Yvette Cedex, France
Ph/Fax: 33 16 908 7554/7584
Laget@phnx7.saclay.cea.fr

RICHARD MILNER
Department of Physics, 26-447
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139
Ph/Fax: (617) 258-5439/258-6923
Milner@mitlns.mit.edu

GIANNI RICCO
Istituto Nazionale di Fisica Nucleare
Sezione di Genova
Via Dodecaneso 33
16146 Genova
Italy
Ph/Fax: 011-39-10-353-6230/39-10-313-358
Ricco@genova.infn.it

DONALD ROBSON
Department of Physics
Florida State University
Tallahassee, FL 32306
Ph/Fax: (904) 644-1767/644-6735
Robson@ds14.scri.fsu.edu

GLEN R. YOUNG
Physics Division MS 6375
Oak Ridge National Laboratory
Oak Ridge, TN 37831
Ph/Fax: (615) 576-2770/2822
Younggr@ornl.gov

Rating†-Days*

PAC9 Recommendations

C-25	E-89-008	Hall C	Inclusive Scattering from Nuclei at $x > 1$ and High Q^2 with a 6 GeV Beam
A	E-91-002	Hall B	Excited Baryons at High Momentum Transfer
A-12	E-91-007/013	Hall C	Measurement of the Nuclear Dependence and Momentum Transfer Dependence of Quasielastic ($e, e'p$) Scattering at Large Momentum Transfers
A	E-91-023	Hall B	Measurement of Polarized Structure Functions in Inelastic Electron Scattering using CLAS
R	E-93-022	Hall B	Production of Vector Mesons by Longitudinal Photons
A-12	PR-94-002	Hall B	Photoproduction of Vector Mesons Off Nuclei
A-30	PR-94-016	Hall B	Measurement of Rare Radiative Decays of the ϕ Meson
A	E-94-017	Hall B	The Neutron Magnetic Form Factor from Precision Measurements of the Ratio of Quasielastic Electron-Neutron to Electron-Proton Scattering in Deuterium
‡	PR-94-023	Hall A	Measurement of small components of the ^3He wave function using $^3\text{He}(\bar{\nu}, e'p)$ in Hall A
C	PR-94-101	Hall A	Precision Measurement of the Neutron Asymmetry A_1^n at large x_{Bj} using CEBAF at 6 GeV
A-16	PR-94-102	Hall B	Electron Scattering from a High Momentum Nucleon in Deuterium
A	PR-94-103	Hall B	The Photoproduction of Pions
A-18	PR-94-104	Hall A	The Fundamental $\gamma n \rightarrow \pi^- p$ Process in ^2H , ^4He , and ^{12}C in the 1.2 - 6.0 GeV Region
R	PR-94-105	Hall A	A Detailed Study of Nuclear Structure Functions $F_2(x_b)$ and $R(x_b)$ in the Valence Quark Region
C	PR-94-106	Hall A	Nucleon Structure Study by Virtual Compton Scattering at High Momentum Transfers
C-24	PR-94-107	Hall A	High Resolution $1p$ Shell Hypernuclear Spectroscopy

Appendix C

C-2

Rating†-Days*

PAC9 Recommendations

C	PR-94-108	Hall A	Electroproduction of Kaons up to $Q^2 = 3(\text{GeV}/c)^2$
A-20	PR-94-109	Hall B	Photoproduction of the ρ Meson from the Proton with Linearly Polarized Photons
C	PR-94-110	Hall C	Measurement of $R = \sigma_L/\sigma_T$ in the Nucleon Resonance Region
R	PR-94-111	Hall C	Longitudinal and Transverse Cross Section in the $d(e,e'p)YN$ Reactions at $Q^2 = 0.5$ to $2(\text{GeV}/c)^2$
D	PR-94-112	Hall A	Polarization Transfer in the ${}^3\text{He}(\bar{e}, e'\bar{p})d$ and ${}^3\text{He}(\bar{e}, e'\bar{p})pn$ Reactions
R	PR-94-113	Hall C	Search for Narrow Excited States of the Proton
R	PR-94-114	Hall C	Search for Direct Conversion of Electrons into Muons
R	PR-94-115	Hall C	Search for Free Quarks
R	PR-94-116	Hall A	Electroproduction of Charged Pions from ${}^1\text{H}$, ${}^2\text{H}$, ${}^{40}\text{Ca}$, and ${}^{208}\text{Pb}$
C-15	PR-94-117	Hall B	Helicity Structure of Pion Photoproduction on Polarized Deuteron and the GDH Sum Rule for the Neutron
C	PR-94-118	Hall B	Search for $J^{PC} = 1^{-+}$ Exotic Mesons in the Electroproduction Reactions using CLAS Detector at CEBAF
D	PR-94-119	Hall A	Study of the $S_{11}(1535)$ Resonance Region via High Precision Eta Electroproduction Measurement
D	PR-94-120	Hall A	Hard Scattering Amplitude for $\bar{e}p \rightarrow e\bar{p}$ in Medium and Heavy Mass Nuclei
C	PR-94-121	Hall B	Exotic Meson Spectroscopy with CLAS

† **A = Approve, C = Conditionally Approve, D = Defer, R = Reject**

‡ See Discussion

* Days for Hall B represents days in addition to already approved days from previously approved experiments. Days for proposals recommended for **C** represent days recommended for approval after meeting specified conditions.

Extension: E-89-008, Hall C
Spokespersons: D. Day, B. Filippone & A. Lung
Title: Inclusive Scattering from Nuclei at $x > 1$ and High Q^2 with a 6 GeV Beam
Scientific Rating: B (See PAC8 Report)

Motivation:

Inelastic electron scattering on nuclei in the kinematic region $x > 1$ is sensitive to high-momentum substructure (nucleons or quarks) in the nucleus. Experiment E-89-008 has been approved to study this process with 4 GeV beams. Studies at 6 GeV will substantially extend the Q^2 range and hence, the utility, of these measurements.

Measurements and Feasibility:

The feasibility of these measurements will be determined by the success of E-89-008.

Issues:

Data collected at 6 GeV will include the kinematic range covered at 4 GeV, so ideally 6 GeV measurements should replace those proposed for the lower energy. However, E-89-008 at 4 GeV will play an important role in the commissioning of the Hall C spectrometer. Therefore, the 4 GeV run is very useful in the overall Hall C program and the experiment should not be delayed until 6 GeV beams are available.

Recommendation:

Conditional approval. With a demonstration of success of the E-89-008 experiment at 4 GeV, the PAC recommends this experiment be upgraded to approval for 25 days.

Extension: E-91-002, Hall B
Spokespersons: V. Burkert, Z. Li, P. Stoler & M. Taiuti
Title: Excited Baryons at High Momentum Transfer

Motivation:

The motivation for the original proposal 91-002 is to study the properties of excited nucleons by means of exclusive single meson production. The extension proposes to exploit the 6 GeV beam to increase the Q^2 range of the experiment from 4 (GeV/c)² to about 7 (GeV/c)².

Measurements and Feasibility:

Apart for the need for reliable 6 GeV beam, no new feasibility issues appear to be raised by this extension. The proposers indicate that simulations of the acceptances and resolutions of CLAS at 6 GeV are quite favorable. Of course, the response of CLAS must be explored experimentally.

Issues:

None, apart for the need for reliable 6 GeV beam.

Recommendation:

Approval of this extension, but the PAC does not see the need to recommend additional time at this point. We ask the experimenters to optimize their running between the 4 and 6 GeV beams. Additional time at 6 GeV will require a future demonstration to the PAC that a need exists.

Extension: E-91-007 & E-91-013, Hall C
Spokespersons: R. Ent & R.G. Milner
Title: Measurement of the Nuclear Dependence and Momentum Transfer Dependence of Quasielastic $(e, e'p)$ Scattering at Large Momentum Transfers
Scientific Rating: B– (See PAC8 Report)

Motivation:

This experiment proposed to search for the onset of color transparency in nuclei. By using the high intensity available at CEBAF and a 6 GeV incident energy, measurements of $(e, e'p)$ cross sections can be extended to higher values of Q^2 than were possible in the experiment already performed at SLAC. Various theoretical calculations show significant differences. The accuracy expected in the proposed measurements will allow one to distinguish between these competing models.

Issues:

This is clearly an experiment which would benefit greatly from going to a 6 GeV incident beam rather than 4 GeV. The committee notes that considerable time is required to obtain the proposed 1% statistical accuracy at the highest Q^2 point. While it is important to go to the highest Q^2 possible, given the uncertainty in the interpretation it may be reasonable to accept somewhat lower experimental uncertainties.

Recommendation:

Approval with an additional 12 days of beam time for these experiments to allow measurements at the highest possible Q^2 .

Extension: E-91-023, Hall B
Spokespersons: V. Burkert, D. Crabb & R. Minehart
Title: Measurement of Polarized Structure Functions in Inelastic Electron Scattering using CLAS

Motivation:

This extension would increase the W and Q^2 range in the measurement of the proton spin structure functions approved for E-91-023. The new data would allow a better test of the “virtual photon” GDH sum rule. The PAC agrees that the physics case for E-91-023 is significantly improved with the availability of 6 GeV beam.

Measurements and Feasibility:

No concerns

Issues:

It appears that by moving the target upstream by 1 meter and running CLAS in reversed polarity, the 6 GeV running would include the kinematics that were originally proposed for 4 GeV running. As this experiment with a polarized target will likely not run early, it is anticipated that 6 GeV beam will be available. It is also expected that 80% beam polarization will be available, allowing for a complete set of measurements with reasonable precision.

Recommendation:

Approval, with no additional beam hours allocated.

Extension: E-93-022, Hall B
Spokespersons: H. Funsten, P. Rubin & E.S. Smith
Title: Production of Vector Mesons by Longitudinal Photons

Motivation:

The collaboration proposes to extend the experiment E-93-022, which measures the final polarization of electroproduced ϕ mesons, to the investigation of the electroproduction rate of ϕ and ρ mesons by virtual photons of known polarization. The Q^2 dependence of the L/T ratio is shown to be sensitive to the mechanism of vector meson production.

Measurements and Feasibility:

Vector mesons would be detected in CLAS by their decay products, performing L/T separation by the Rosenbluth procedure at beam energies from 2.4 to 6.0 GeV.

Issues:

The PAC recognizes the interest of the physics program, but notices that the measurement cannot be considered as a straightforward extension of E-93-022. Rather it refers to LOI 94-003. The PAC confirms the concern, already expressed after the LOI, about the degree of reliability and precision obtainable in a L/T separation with CLAS.

Recommendation:

Before a proposal is submitted, a test of L/T separations on a previously measured reaction should be performed to show the available accuracy. The present request for an extension is recommended for rejection as it is not a straightforward extension of E-93-022.

Proposal Update: PR-94-002, Hall B
Spokespersons: P.-Y. Bertin, M. Kossov & B. M. Preedom
Title: Photoproduction of Vector Mesons Off Nuclei

Motivation:

This experiment proposes to examine inclusive e^+e^- photoproduction in the incoherent production region in order to seek evidence for possible modification of vector meson properties (mass, width, relative phase) in the presence of the nuclear medium.

Measurements and Feasibility:

The measurement will be accomplished by measuring the e^+e^- cross section in the incoherent region simultaneously from a series of nuclear targets. While the proponents allege that the analysis of data will be sensitive to a vector meson mass shift as small as 20 MeV via comparison of results on lead and deuterium, PAC was not convinced that this would be possible given the many effects that were *not* included in the model-calculation. Nevertheless, measurement of the vector meson shape in nuclei, as well as the associated A -dependence is of considerable interest, both intrinsically and as a prelude to future RHIC work.

Issues:

Much more sophisticated modelling must be done in order to interpret the data in terms of modification of vector meson properties in the nuclear medium. The PAC suggests that the sequential target configuration be further optimized to reduce systematic errors.

Recommendation:

Approval for 12 days.

Proposal Update: PR-94-016, Hall B

Spokespersons: A. R. Dzierba & J. Napolitano

Title: Measurement of Rare Radiative Decays of the Phi Meson

Motivation:

The goal of this experiment is to measure rare (B.R. $\leq 10^{-4}$) radiative decays of the $\phi(1020)$ in order to study the structure of daughter states as well as to probe possible symmetry violations. Sensitivity to branching ratios at this level would permit significantly improved charge conjugation tests for modes such as $\phi \rightarrow \omega\gamma$ as well as provide important information about the structure of the heretofore poorly understood scalar states a_0 and f_0 .

Measurements and Feasibility:

Since the last PAC Meeting a substantial amount of work on the feasibility and technical aspects of the proposed measurements has been carried out. Both electromagnetic and hadronic backgrounds have been shown to be acceptable and the BNL effort has provided valuable experience for the CEBAF experiment. The PAC is impressed with the momentum of the collaboration at this early stage.

Issues:

None.

Recommendation:

Approval for 30 days.

Extension: E-94-017, Hall B
Spokespersons: W.K. Brooks & M.F. Vineyard
Title: The Neutron Magnetic Form Factor from Precision Measurements of the Ratio of Quasielastic Electron-Neutron to Electron-Proton Scattering in Deuterium

Motivation:

This extension proposes the measurement of the magnetic elastic form factor of the neutron up to a momentum transfer of $7.5 (\text{GeV}/c)^2$. This would enlarge the range of measurements proposed in E-94-017.

Measurement and Feasibility:

The neutron form factor is determined from a comparison of quasi-elastic $d(e, e'p)$ and $d(e, e'n)$ measurements using the CLAS. The proposed extension is a relatively straightforward continuation of the approved experiment with the exception that the backgrounds increase significantly with Q^2 as a result of the reduction of the quasielastic relative to the deep-inelastic responses.

Issues:

The request for an extension states that there is no overlap between the points to be measured with beam energies of 2.4 and 6 GeV but that there is considerable overlap of each set with those to be measured at 4 GeV. We therefore do not see the need for additional time. If, after optimizing the times for the different incident energies, there is a need for additional time to complete the proposed program of measurements, a further request should be made to the PAC.

Recommendation:

Approval with no additional time.

Proposal Update: PR-94-023, Hall A

Spokesperson: F. W. Hersman

Title: Measurement of Small Components of the ^3He Wave Function using $^3\text{He}(e,e'p)$ in Hall A

Recommendation:

PAC8 recommended that PR-94-020 and PR-94-023 be deferred and that the proposals be combined. Deferred proposals must be resubmitted at one of the two subsequent PAC meetings or be downgraded to rejected status. In the absence of a resubmission of PR-94-020 at PAC9, the PAC withholds its recommendation regarding PR-94-023 pending the outcome of PAC10.

Proposal: PR-94-101, Hall A
Spokespersons: Z.-E. Meziani & P.A. Souder
Title: Precision Measurement of the Neutron Asymmetry A_1^n at large x_{Bj} using CEBAF at 6 GeV

Motivation:

It is proposed to measure the deep inelastic neutron asymmetry A_1^n at large x using a polarized ^3He target and the 6 GeV CEBAF polarized beam. Such a measurement is complementary to the high energy experiments at DESY and SLAC. A_1^n at large x is predicted to be large and positive.

Measurements and Feasibility:

The PAC rates the physics motivation as high and accepts that a measurement of the quality proposed would have a significant impact on our understanding of nucleon structure. As the CEBAF maximum energy rises to and above 6 GeV, the inclusive deep inelastic window opens to allow a number of significant measurements on nucleon structure. The proposal capitalizes on this feature. As proposed, the experiment is judged to be feasible, but the PAC is of the opinion that it is not optimized.

Issues:

The projected results are obtained assuming delivery of high polarization, high intensity electron beam and routine operation of the polarized target for many months. Both of these assumptions have to be demonstrated. In addition, the PAC cautions that the extraction of g_1^n from the precise measurement on ^3He may be complicated by the corrections for the D -state admixture in the nuclear ground state. Further, the PAC was not convinced that the spectrometer arrangement was optimized for the proposed measurement. These issues must be resolved before approval could be given to this ambitious, high impact experiment.

Recommendation:

Conditional approval.

Proposal: PR-94-102, Hall B
Spokesperson: S. E Kuhn & K. Griffioen
Title: Electron Scattering from a High Momentum Nucleon in Deuterium

Motivation:

Measurements are proposed of the semi-inclusive cross section for scattering 6 GeV electrons from a fast moving neutron in deuterium and observing the spectator proton in the backward hemisphere with momentum values in the range (0.25 - 0.60) GeV/c.

If the proton is a mere spectator, its momentum combined with the missing mass of the reaction gauges the off-shellness of the neutron. With 6 GeV electrons the experiment can just reach into the Bjorken scaling region to gain information on tagged deep inelastic structure functions.

The large out-of-plane coverage of CLAS allows to separate to some extent the role of the wave function and to determine the ratio of longitudinal and transverse structure functions of the off-shell neutron.

Whereas PAC9 has its reservations concerning the validity of the simplistic spectator model - for example meson exchange currents may be important and contaminate the momentum tagging of the recoiling proton - it finds the proposed measurements in the relatively simple two-nucleon system interesting, in particular in deep inelastic scaling kinematics.

Measurements and Feasibility:

The measurements can be done with standard CLAS settings.

Issues:

The beam time request amounts to 16 full days plus overhead if the luminosity available is $10^{34} \text{cm}^{-2} \text{s}^{-1}$ and a fully calibrated CLAS detector is available.

Recommendation:

Approval for 16 days.

Proposal: PR-94-103, Hall B
Spokespersons: W. J. Briscoe, J. Ficenec & D. Jenkins
Title: The Photoproduction of Pions

Motivation:

The physics motivation behind these measurements lies in improving the accuracy of photocoupling amplitudes for numerous baryon resonances. Such data are needed as a precision test of quark models and can facilitate a coupled channel analysis of $\pi N/\eta N$ production. At the highest energies, the asymptotic QCD prediction of helicity conservation may be examined.

Measurements and Feasibility:

Single-pion photoproduction using CLAS and the Tagger Facility in Hall B will be measured at beam energies of 1.6, 2.4 and 3.2 GeV. These experiments will allow an accurate calibration of the tagged photon beam, target characteristics, and CLAS acceptance for charged particles in the angular range $\theta_{\text{CM}} = 20^\circ$ to 140° . The proposed measurements can be made to a large extent in Phase I by running concurrently with previously approved CLAS experiments (89-004, 91-008, 93-033, 94-015) using a hydrogen target and experiments (89-045, 93-008, 94-017, 94-008) using a deuterium target. Additional new time (11 days) would be needed to carry out the proposed Phase II measurements on deuterium with the 3.2 GeV beam.

Issues:

The PAC recognizes the need for a much improved data set in the resonance region for pion photoproduction. At the higher energies such as proposed in Phase II, the lack of polarization data will not allow an unambiguous partial wave analysis to be carried out. Analysis of some of the Phase I data should be completed before time is approved for Phase II.

Recommendation:

Approval for Phase I run concurrently with previously approved CLAS experiments (82 days).

Proposal: PR-94-104, Hall A
Spokesperson: H. Gao & R. J. Holt
Title: The Fundamental $\gamma n \rightarrow \pi^- p$ Process in ^2H , ^4He , and ^{12}C in the 1.2 - 6.0 GeV Region
Scientific Rating: B+

Motivation:

Measurements of this fundamental reaction will provide another interesting setting in which to look for the onset of constituent counting rules. No data presently exist for $E_\gamma > 2$ GeV. Comparison of the ratio for production of π^+/π^- is predicted to approach 1/4 at high s and t in quark model calculations. This ratio will be measured up to $t = 5$ (GeV/c) 2 . A third element in the proposal is to measure the transparency of the $\gamma n \rightarrow \pi^- p$ quasi free process in the nuclei ^4He and ^{12}C .

Measurements and Feasibility:

Measurements would be carried out by detecting the pion and proton in coincidence using the HRS spectrometers in Hall A. A thick copper radiator would be used to produce the bremsstrahlung photons. Several incident beam energies, up to 6.0 GeV, are required. The inefficient use of the cryogenic target in Hall A would result in significant overhead. Care must be taken to minimize systematic errors since not all targets can be put in the beam at the same time.

Issues:

The first two motivations, i.e., the test of scaling and the measurement of the ratio of π^+/π^- , are important and will be addressed well by the proposed data. The measurements of transmission and questions of medium modification will also benefit from the coincidence with the potential of separating lifetime from transparency dependencies. However, this part of the proposal is more speculative and the PAC recommends that the measurements on hydrogen isotopes and ^4He be carried out first. The case for ^{12}C can be reconsidered later.

Recommendation:

Approval for 18 days.

Proposal: PR-94-105, Hall A
Spokesperson: N. Bianchi, J. Gomez & A. Saha
Title: A Detailed Study of Nuclear Structure Functions $F_2(x_b)$ and $R(x_b)$ in the Valence Quark Region

Motivation:

This experiment would use deep inelastic scattering on a series of four cryogenic and four solid targets in order to measure cross sections, $F_2(x_b)$ and σ_L/σ_T over a range of nuclei. The experiment would explore the valence quark region $0.1 \leq x \leq 0.6$.

Measurements and Feasibility:

The measurement appears to be feasible as described. However, there exist practical problems associated with the use of the cryogenic target which result in substantial overhead.

Issues:

The PAC agrees that this is an arena wherein CEBAF can in principle make an important contribution. However, a number of problems were perceived with the program proposed. The proponents have attempted to perform as comprehensive a set of experiments as possible, but in doing so it is clear that the proposed studies are not optimal for *any* of the various measurements. Consideration of where and how CEBAF impact would be maximized must be a crucial element of any future proposal. Another concern is the extremely high ($\sim 3:1$) ratio of time allotted for configuration changes versus that given to data taking.

Recommendation:

Rejection.

Proposal: PR-94-106, Hall A
Spokespersons: V. Breton & C.E. Hyde-Wright
Title: Nucleon Structure Study by Virtual Compton Scattering at High Momentum Transfers

Motivation:

These proposed studies of virtual Compton scattering (VCS) would extend the measurements in E-93-050 above the resonance region. The t distribution of the Compton photons is sensitive to internal structure of the proton, *e.g.*, to correlations such as diquarks. This experiment would open new territory that should be an object of the 6 GeV CEBAF program.

Measurements and Feasibility:

This experiment requires 6 GeV beam. The proponents make a convincing case for the feasibility of the proposed measurements using the Hall A spectrometers to identify VCS events by kinematics. Nevertheless, the PAC has residual concerns:

- Will kinematic π^0 - γ separation actually be adequate?
- Will sufficiently detailed understanding of the Bethe-Heitler tail be possible?

Experience gained in E-93-050 should be useful in resolving these concerns.

Issues:

It is not clear that the theoretical understanding required to relate the measurements to the internal structure of the nucleons is adequate. The proponents should encourage theoretical effort to insure optimal use of the data.

Recommendation:

Conditional approval subject to the success of the E-93-050 experiment.

Proposal: PR-94-107, Hall A
Spokespersons: S. Frullani, F. Garibaldi, P. Markowitz & T. Saito
Title: High Resolution $1p$ Shell Hypernuclear Spectroscopy
Scientific Rating: B+

Motivation:

A weak-coupling picture of Lambda-hypernucleus structure predicts the low-lying levels can be understood as those of the core ($A-1$) nucleus coupled to the Lambda and exhibiting a doublet structure whose splitting is determined by the Lambda-nucleon spin-spin and spin-orbit terms. The spacing of these doublets depends in addition on the spin-orbit term related to the nucleon's spin. Electroproduction of Lambda-hypernuclei via $(e, e'K)$ reactions results in sufficient spin-flip strength to excite both members of the doublet, in contrast to the situation with (K^-, π^-) (no spin flip) and (π^+, K^+) (weak spin flip). By performing these measurements using the HRS at CEBAF, sufficient experimental resolution is achievable to resolve the doublets. This resolution is projected to be of the order of 300-400 keV as opposed to the 1-2 MeV typical of previous hadroproduction experiments, thus opening new possibilities in the area of hypernuclear spectroscopy and in learning about the Lambda-nucleon interaction in nuclei.

Measurements and Feasibility:

Both the HRS systems in Hall A would be operated at forward angles. The virtual photon flux is enhanced by detecting the electron at forward angles, and the momentum transfer to the nucleus is minimized by detecting the final kaon nearly along the direction of the virtual photon, thus enhancing the survival probability of the hypernuclei produced. A 4 GeV beam of 100 μ A and the standard HRS detection packages would be used, with some possibility of "tuning" the index of refraction of the aerogel Cerenkov detector to optimize K/π separation for the kaon momenta of interest in a given case. The ^7He , ^9Li , ^{12}B and ^{16}N lambda-hypernuclei would be studied using targets of ^7Li , ^9Be , ^{12}C and ^{16}O , respectively. The ^{16}O target would be realized as a "waterfall" target of the type already used by the group; this also gives access to a proton target, which allows measurement of the elementary cross section $p(e, e'K)\Lambda$ in the appropriate kinematical range. Full advantage of the good beam duty factor is used to minimize accidental rates. Resulting counting rates are of the order of 0.5 - 35 counts/hour each for several low-lying states in each nucleus, which is adequate to extract peak positions and gives some margin against uncertainty in the relevant cross sections.

Both spectrometer magnets would need to be equipped with septum magnets to enable operation at 6 degrees; this leads to unavoidable second-order aberrations which must be handled by reconstructing the target z position accurately, as is done with an extended target. A segmented target is used to reduce multiple scattering contributions to the resolution while enhancing the count rate by a factor of 5.

Issues:

Singles rates are expected to be large, particularly in the electron arm. A pernicious source is likely to be electrons and notably photons produced in the target which then interact with spectrometer poles and apertures, creating scattered electrons and e^+/e^- from photon conversions, all of which may overwhelm the detection system. The septum magnets will cause unavoidable distortions which require careful

Proposal: PR-94-107 (continued)

mapping and iterative tracking techniques in compensation. The target must move 80cm upstream, necessitating construction of a new scattering chamber. The waterfall target requires a special enclosure with thin metal windows (nickel or stainless steel) in order to preserve the vacuum in the rest of the spectrometer and avoid the need for windows, which would degrade the resolution excessively beyond the <500 keV which must be achieved for the experiment to meet its goals.

Recommendation:

Conditional approval, subject to the following technical study. CEBAF should commission a Technical Review to address the issues of performance of the HRS with the septum magnets installed and of the impact of all expected sources of background. Following successful resolution of these issues, the proposal is recommended for approval of the requested 24 days in Hall A.

Proposal: PR-94-108, Hall A
Spokespersons: O.K. Baker, C.C. Chang, S. Frullani, M. Iodice & P. Markowitz
Title: Electroproduction of Kaons up to $Q^2 = 3(\text{GeV}/c)^2$

Motivation:

The aim is to obtain high precision data over a broad kinematical range for three of the four unpolarized response functions. Sensitivity of this type of data to model assumptions should allow the various electroproduction mechanisms to be tested over a wide range of Q^2 .

Measurements and Feasibility:

Measurements for this experiment require a 6 GeV beam. A hydrogen target will need the 6.0 GeV beam for each Q^2 measurement in order to obtain separation of the three responses. This data overlaps at one value of $Q^2 = 1.5(\text{GeV}/c)^2$ with the approved Hall C experiment PR 93-018 and considerably extends the range of Q^2 and W for this reaction. The extraction of the K^+ hyperon form factor will be challenging.

Issues:

The PAC believes that significant improvements can be made in particle identification, particularly for K^+/p . The goal of achieving 2% systematic error is ambitious. An assessment of the errors involved for the various responses is needed to evaluate the significance of the L/T separation. Data on the longitudinal and transverse cross sections from Hall C experiment E-93-018 should be used in estimating the expected errors specific to the $(e, e' K^+)$ reaction.

Recommendation:

Conditional approval depending on a realistic assessment of errors and a successful demonstration of L/T separation in the Hall C experiment.

Proposal: PR-94-109, Hall B
Spokesperson: P.L. Cole, J.P. Connelly & R.R. Whitney
Title: Photoproduction of the ρ Meson from the Proton with Linearly Polarized Photons

Motivation:

This experiment would study baryon resonances via rho meson photoproduction with linearly polarized photons in the CLAS. By measuring decay angular distributions with polarized photons it may be possible to extract the complete spin density matrix or helicity amplitudes for a mass range ($M_{N^*} = 1.66 - 2.22$ GeV) that includes many unobserved states that are predicted in the quark model. The additional detailed information provided by this experiment could provide a very sensitive search for these states as well as improve our understanding of the previously observed states.

Measurements and Feasibility:

This proposal requires the installation of a diamond crystal radiator for the production of linearly polarized photons from coherent bremsstrahlung. This could be a useful device for Hall B and appears to be technically straightforward. Coverage for the full energy range requires two settings for the photon tagger: one at 4 GeV ($E_\gamma = 0.8 - 1.6$ GeV) and one at 6 GeV ($E_\gamma = 1.2 - 2.4$ GeV). Detailed acceptance studies have been done. Studies of the backgrounds indicate that they are manageable.

Issues:

The extraction of the complete spin density matrix from the measurements was not convincingly demonstrated, although this appears to be an analysis problem that is solvable.

This experiment could partially take advantage of the proposed Compton backscattering facility for the energy range below 1.8 GeV. However, the higher energy running cannot be done with this facility.

Recommendation:

Approval for 11 days at 4 GeV and 9 days at 6 GeV.

Proposal: PR-94-110, Hall C
Spokespersons: C. Keppel
Title: Measurement of $R = \sigma_L/\sigma_T$ in the Nucleon Resonance Region

Motivation:

The proposed experiment aims to obtain a data set of improved accuracy of the ratio of longitudinal over transverse cross sections $R(Q^2)$ in the range of momentum transfer $Q^2 = (0.75-7.5)(\text{GeV}/c)^2$ across the nucleon resonance region. The physics motivation is to test with better accuracy duality in the separated responses and to revisit the issue of the scaling behavior of the Δ transition form factor.

Issues:

Clearly the L/T ratio on the proton is a fundamental quantity that should be measured with the best possible accuracy. However, the PAC is not convinced that the claimed accuracy, which is very ambitious, is realistic. In particular, the systematic error sources should be evaluated one by one and minimized by appropriate experimental measures. In addition, a subset of the proposed kinematics should be selected in order to first demonstrate the claimed accuracy. It is also of importance to make a connection kinematically with the high energy SLAC data of $R(Q^2)$.

Recommendation:

Conditional approval.

Proposal: PR-94-111, Hall C
Spokesperson: S. Beedoe, O.K. Baker & P. Markowitz
Title: Longitudinal and Transverse Cross Section in the $d(e,e'p)YN$ Reactions at $Q^2 = 0.5$ to $2(\text{GeV}/c)^2$

Motivation:

The purpose of this proposal is to make the first L/T separation in $d(e,e'p)YN$. Information on the neutron amplitudes would also be obtained by subtracting information from a proton target in the same kinematics. These data would later be used to search for medium modifications in heavier systems.

Measurements and Feasibility:

Monte Carlo simulations and count rate estimates indicate that the experiment is possible.

Issues:

The PAC was pleased to see an improvement in the proposal but several serious concerns still remain to be addressed:

- 1) Convincing arguments have not been given to justify the use of virtual photons (as contrasted to real photons) to study K^+ production on deuterium.
- 2) Will this experiment permit disentangling of ΛN scattering in the 3S_1 and 1S_0 states?
- 3) Are the energy resolution and statistical accuracy good enough to study the ΣN cusp region?
- 4) The method proposed to extract the neutron amplitude was not convincing. A more exclusive experiment may be necessary to identify the Σ^- .

Recommendation:

Reject.

Proposal: PR-94-112, Hall A
Spokespersons: E. J. Brash, R.D. Ransome & P.M. Rutt
Title: Polarization Transfer in the $^3\text{He}(\vec{\epsilon}, e'\vec{p})d$ and $^3\text{He}(\vec{\epsilon}, e'\vec{p})pn$ Reactions

Motivation:

Recent experiments in light and medium nuclei have observed a significant difference between the longitudinal and transverse response functions. In particular, the ratio related to G_M^p/G_E^p for the bound proton appears to be increased by about 25% over its free value, practically independent of mass number, nuclear shell and momentum transfer. At present there exists no completely convincing theoretical argument for such a strong medium modification. The goal of experiment PR 94-112 is to determine this ratio in a novel way by measuring the spin-transfer coefficients whose ratio is expected to be rather insensitive to final state interactions and meson exchange currents in the case of the two-body breakup channel. In addition, the three-body breakup channel would be studied in order to extract information on the small S' component of the ^3He wave function.

Measurements and Feasibility:

The experiment would need the missing mass resolution of the Hall A HRS spectrometers to distinguish between the two- and three-body breakup channels. The focal plane polarimeter is required to measure the polarization of the emitted proton.

Issues:

The committee agrees that ^3He is an appropriate nucleus on which to perform the experiment. There is a strong increase in binding energy and correlations in passing from ^2H to ^3He to ^4He . Realistic Faddeev calculations can be performed for ^3He , and a better understanding of its wave functions is prerequisite for using it as a neutron target. The committee has not been convinced, however, that the present experiment would be sensitive to the small wave function components of ^3He . The physics discussed in the second part of the proposal must be delineated more crisply. There is also concern about the proposed target cooling system and the large amount of mass surrounding the target. Cryogenic cooling should be considered. Any future proposal should select kinematics and target equipment as similar as possible to that of experiments PR-93-120 and E-93-049.

Recommendation:

Defer.

Proposal: PR-94-113, Hall C
Spokesperson: D. Garelick
Title: Search for Narrow Excited States of the Proton

Motivation:

The objective of this proposal is to search for a narrow excited state of the proton. It was suggested that color octet states would occur at higher mass than a color antisymmetric state. The excited, “color-charged” proton would then be surmised to decay by a “color-charged” photon.

Measurements and Feasibility:

The experiment is straightforward electron scattering from the proton similar to experiments which have been performed as either calibrations or studies of the proton at all electron scattering laboratories. Energy resolution is likely to be important since the proposed process is likely to have a vanishingly small width.

Issues:

The physics arguments for an excited proton state with color were not convincing.

Although some Bates data were presented, the PAC was not convinced that already existing data from recent experiments at SLAC and other electron scattering laboratories were considered in setting present limits.

Recommendation:

Reject.

Proposal: PR-94-114, Hall C
Spokesperson: D. Garelick
Title: Search for Direct Conversion of Electrons into Muons

Motivation:

The purpose of the proposed experiment is to search for the conversion of electrons to muons by exchange with a proton of a hypothetical particle carrying both electron and muon flavor quantum numbers.

Measurements and Feasibility:

This experiment would measure muons with the HMS spectrometer in Hall C at beam energies of 0.3 and 4 GeV. The detector package in the HMS is not presently configured to detect muons. No details are given regarding muon detection. No convincing case has been made for the effective elimination of background muons.

Issues:

The implications of the existence of the postulated particles on known processes have not been comprehensively examined. The proposed experiment is extremely difficult to perform convincingly, even at the level of sensitivity indicated. This proposal is inconsistent with the level of accuracy required for such an experiment.

Recommendation:

Reject.

Proposal.: PR-94-115, Hall C
Spokesperson: D. Garelick
Title: Search for Free Quarks

Motivation:

This proposal would search for the production of free quarks from a carbon target. The focus of the search is for quarks that have a very strong long range interaction and may have escaped detection.

Measurements and Feasibility:

The proposal suggests that the standard HMS spectrometer and detector package would be used for the search. The spectrometer would be set at a momentum above the beam momentum (for charge = -1) to observe the fractional charge.

Issues:

A detailed comparison with existing searches and the relative sensitivities was not presented. The PAC is not convinced that the standard detector package of the HMS is useful for this search.

Recommendation:

Reject.

Proposal: PR-94-116, Hall A
Spokespersons: R. G. Badalian & T. Eden
Title: Electroproduction of Charged Pions from ^1H , ^2H , ^{40}Ca , and ^{208}Pb

Motivation:

The proposed experiment has as goals the measurements of:

- nuclear color transparency by comparing the ratio of π^+ mesons produced off nuclei and off the nucleon,
- the hadronization process as function of production time *vs.* formation time,
- multipion production off the proton with the aim to subtract nucleon resonances and vector mesons from the spectra in order to extract pion production off free quarks, and
- the ratio of π^+ and π^- mesons produced off the nucleon in order to compare with various models (vector meson dominance, quark knockout, annihilation).

Measurements and Feasibility:

The experiment would be performed in Hall A with a 6 GeV beam using the HRS system to detect the scattered electron and one of the produced pions. Cryogenic hydrogen and deuterium as well as solid targets would be used.

Issues:

The proposal describes a large number of theoretical models and expectations. However, it is not well focused and not specific about how its goals could be reached. A large data base will be provided by already approved experiments on the production of pions and vector mesons. It was not clear from the presentation which additional data would be necessary to probe the theoretical conjectures. There are also serious doubts whether these issues can be settled in the available kinematical region. Neither the Born approximation in terms of nucleon and pion pole terms nor a parametrization in terms of quark distributions and quark-pion fragmentation functions will be meaningful at these intermediate energies. Since the cross section will be dominated by nucleon resonances and vector mesons, the “meson production off quarks” cannot be extracted in a meaningful way. On the issue of color transparency, the PAC expresses its concern that these effects may have been overestimated in the proposal. Moreover, calculations for ^4He have shown that wave function correlations give rise to considerably larger effects in the available kinematical region. In order to find out how these competing effects behave in nature, it will be useful to explore the situation in ^4He first (proposal PR 94-104). Depending on the results of such an experiment, it may be useful to come back to heavier nuclei.

Recommendation:

Reject.

Proposal: PR-94-117, Hall B
Spokespersons: J.P. Chen, S. Gilad, Zh. Li & C.S. Whisnant
Title: Helicity Structure of Pion Photoproduction on Polarized Deuteron and the GDH Sum Rule for the Neutron

Motivation:

This experiment would measure the helicity $1/2$ and $3/2$ cross sections for one and two pion photoproduction on the neutron at energies between 0.28 and 2.2 GeV using a circularly polarized photon beam and a polarized target. These would be the first “double polarization” data for the neutron at CEBAF. In addition, by measuring either a charged or neutral particle in the final state, the total helicity-dependent cross sections can be measured. These cross sections can be used to determine the contribution to the GDH sum rule in this energy region.

Measurements and Feasibility:

This measurement would utilize the tagged circularly polarized photon beam and the CLAS detector in Hall B. The polarized target proposed is solid HD. For the all neutral decays (*e.g.* $\gamma n \rightarrow n \pi^0$) either a photon or the neutron will be detected.

Issues:

The HD target technology being developed for LEGS polarized target experiments appears promising, but is not yet demonstrated.

Recommendation:

Conditional approval. When successful operation of the target is demonstrated, the PAC recommends the experiment be upgraded for approval for 15 days.

Proposal: PR-94-118, Hall B
Spokespersons: I. Aznauryan, H. Funsten & S. Stepanyan
Title: Search for $J^{PC} = 1^{-+}$ Exotic Mesons in the Electroproduction Reactions using CLAS Detector at CEBAF

Motivation:

Exotic hybrids have been the object of many searches. Although some results have been tantalizing, all reported signals have been marginal at best. There is now substantial theoretical motivation to search for decays of hybrids (called $\hat{\rho}$ here) with $J^G = 1^-$ and $J^{PC} = 1^{-+}$ $\eta\pi$ and $\eta'\pi$ modes. Models suggest that branching fractions for $\eta\pi$ may be near 0.1, while those for $\eta'\pi$ modes may be larger by a factor of 3 or more. An estimate of the cross section for $\hat{\rho}$ photoproduction based on the a_2 photoproduction cross section suggests that the $\hat{\rho}^+$ electroproduction rates at CEBAF may be sufficient for a feasible discovery experiment.

Since discovery of these exotic mesons would be a major achievement for CEBAF, this proposal is very interesting and attractive, although it is equally speculative.

Measurements and Feasibility:

This experiment requires 6 GeV beam.

The proponents propose to observe $\hat{\rho}^+ \rightarrow \pi^+\eta(\eta')$ and $\hat{\rho}^0 \rightarrow \pi^0\eta(\eta')$ using the $\eta \rightarrow \gamma\gamma$ and $\eta' \rightarrow \rho^0\gamma$ modes. All charged pions or photons resulting from these decays or daughter decays, the scattered electron, as well as the recoil proton (in $\hat{\rho}^0$ production) can be detected in the CLAS detector. Hence, the only missing particle would be the n in $\hat{\rho}^+$ production. Altogether, detection of 2 or 4 charged particles in coincidence with 1 to 4 photons is required!

By design, the CLAS detector is well-suited for detecting these multibody final states. The model estimates of cross sections and branching fractions mentioned above lead to an estimated counting rate of ~500 events per day and the signal to background ratio may be as high as 4:1 or 5:1. If these estimates are reliable, the proposed 30-day run would provide ~15,000 events, enough for a decisive discovery. However, the experiment requires that both the charged particle and photon detectors in the CLAS system must work very well and the acceptances and reconstruction efficiencies must be well-understood. Therefore, the proposed experiment should not be attempted until the Hall B group has demonstrated that they understand the performance of the CLAS detector. This experience will naturally be gathered in the commissioning and calibration of the detector and does not require a 6 GeV beam.

Issues:

The CLAS detector must work quite reliably for an experiment with events of this complexity. This implies that the experiment cannot be done for several (perhaps as many as four) years.

In the meantime, much may be learned about exotic mesons; indeed the exotic mesons and the decay modes discussed in the proposal may have been discovered or sufficient negative evidence to rule them out may have been accumulated. Either way, it would be difficult to justify 30 days of Hall B running for the search at this time.

Proposal: PR-94-118 (continued)

On the other hand, no major long lead-time investments in hardware or software that are specific for this experiment are required, so the impact of deferred approval is minimal. Indeed, work on the commissioning, calibration, and understanding of the CLAS detector would be the wisest investment of effort leading toward the proposed experiment.

Recommendation:

The PAC recommends conditional approval of this experiment. Sufficient experience with the CLAS detector should be acquired to insure that the detector performance is adequate for studying these complex multibody final states. In addition, progress in our knowledge of exotic mesons from experiments elsewhere must be taken into account.

Proposal: PR-94-119, Hall A
Spokespersons: W. Bertozzi & A.J. Sarty
Title: Study of the $S_{11}(1535)$ Resonance Region via High Precision Eta Electroproduction Measurement

Motivation:

The proposal aims to obtain high precision and high resolution data for the $p(e, e'p)\eta$ reaction in the energy region up to approximately 20 MeV above threshold. These data should allow to disentangle s -, p - and d -waves in order to separate small contributions of overlapping $P_{11}(1440)$, $D_{13}(1520)$ and non resonant Born terms from the dominant $S_{11}(1535)$ amplitude. These data, together with the results of Hall B E-89-039 experiment, would constrain eta production models in the resonance region.

Measurements and Feasibility:

The experiment performs complete angular distributions inside the acceptance of the HRS spectrometer in Hall A by exploiting the kinematical focusing of emitted protons in the momentum transfer direction. Data would be taken with high statistical precision at $Q^2 = 3$ and 4 $(\text{GeV}/c)^2$ and a Rosenbluth separation would also be performed at $Q^2 = 0.65(\text{GeV}/c)^2$ for the first 4 MeV above threshold.

Issues:

The PAC is concerned that the desired information on the $S_{11}(1535)$ resonance cannot be reliably extracted in this experiment. The separation of resonant and non-resonant s -wave components from a limited energy range close to threshold is complicated by the uncertainties in distorted wave effects near threshold. PAC believes that a preliminary investigation of the electroexcitation of the S_{11} resonance over a wide energy range, as performed by experiment E-89-039, will provide a useful knowledge of the resonant amplitude necessary for a quantitative evaluation of more detailed effects. The PAC recognizes the interest in an independent precision measurement near threshold. However, the contributions of the $P_{11}(1440)$ and $D_{13}(1520)$ resonances to η production are expected to be very small, and sensitivity of the various structure functions to small p - and d -wave admixtures should be studied in more detail.

Recommendation:

Defer.

Proposal: PR-94-120, Hall A
Spokespersons: R. Gilman, P.R. Rutt, E.J. Brash & S. Nanda
Title: Hard Scattering Amplitude for $\bar{e}p \rightarrow e\bar{p}$ in Medium and Heavy Mass Nuclei

Motivation:

The experiment aims at measuring the spin transfer coefficients in the $\bar{e}p \rightarrow e\bar{p}$ reaction induced in medium and heavy nuclei. The first goal is to determine the ratio between the Coulomb and the transverse response function of nuclei, in a way which does not suffer from the difficulties and the uncertainties of the traditional Rosenbluth separation method. This measurement could eventually lead to a determination of the ratio G_M/G_E of the nucleon form factors in a nuclear medium. The second goal is to attack the problem of color transparency in an original way: by looking at the variation of the spin transfer coefficients with the mass of the target nuclei.

Issues:

While the committee has some concerns about the study of the onset of color transparency in the CEBAF energy range, it feels that a precise $\bar{e}p \rightarrow e\bar{p}$ determination of the Coulomb and the Transverse response functions is relevant and may shed new light on the long-standing problem of the suppression of the Coulomb nuclear response function.

However, the committee believes that the time request is too large and feels that the collaboration should put its proposal in a perspective which includes other experiments. It should therefore make a strong case for the study of only one heavy nucleus, in addition to ^4He (E-93-049).

Recommendation:

Defer.

The committee recommends that the collaboration focus on the study of the determination of the spin transfer coefficient on one target only and come back with an integrated program which couples the study of the previously accepted proposal on ^4He with those proposed on ^{12}C . The proponents should seek to perform this program with equipment as similar as possible and under the same kinematic conditions.

Proposal: PR-94-121, Hall B
Spokespersons: G. Adams & J. Napolitano
Title: Exotic Meson Spectroscopy with CLAS

Motivation:

The experimenters propose to search for exotic hybrid mesons that are predicted to lie in the mass range of 1.3-2.5 GeV. Hybrids can be identified by their distinctive quantum numbers, such as $J^{PC} = 0^{+-}, 1^{-+}, 2^{+0}$, etc., and their decay modes.

Measurements and Feasibility:

The experimenters propose to photoproduce neutral hybrids, in particular the 1^{-+} states, from a hydrogen target. The hybrids will be detected by their decays into favored modes, such as πb_1 , that lead to final states with four or more charged mesons. The $\eta\pi$ decay channel may also be detectable.

The experimenters propose to use the CLAS spectrometer, arguing that it is suitable for an initial survey despite its limited azimuthal acceptance at forward angles. The acceptance will be improved by moving the position of the target center upstream 1.5 meters. The proposed beam energy is 5-6 GeV. With the assumption of a πb_1 production cross section of 1 nb, 4000 counts would be obtained in a live time of 450 hours.

A search with these parameters appears feasible given the necessary beam energy and expected performance of CLAS.

Issues:

The experiment depends on the availability of beam at 5-6 GeV and on CLAS performing reliably. Other searches for hybrid meson will be made elsewhere and could affect the context of this proposal.

Recommendation:

Conditional approval until sufficient experience has been gained with CLAS to allow an assessment of its reliability for the required multimeson final states. In addition, progress in our knowledge of exotic mesons from experiments elsewhere must be taken into account.

Letter-of-Intent: LOI-94-101
Spokespersons: A.T. Margarian
Title: The Heavy Hypernuclei Lifetime Direct Measurement at CEBAF

The free lambda-hyperon lifetime is expected to be changed in a hypernucleus since nonmesonic weak decays can proceed via two-body interaction with a nucleon. The resulting energy release corresponds to nucleon momenta well above the Fermi momentum, making the decay not Pauli-blocked, resulting in a large increase in the decay width. In heavy nuclei the nonmesonic decay rates can dominate over the usual pi-mesonic branches expected in light hypernuclei. The few measured widths exhibit enhancements up to a factor of 50 over the free-space width for hypernuclei up to $A=12$, although there is large (factor of 10) scatter in the data. The effect in nuclei of $A=200$ would be among the largest, and might be studied by means of delayed fission of the resulting hypernucleus.

A 1.6 GeV electron beam would bombard a thin (2 mg/cm^2) Bi target, producing hyper-Pb via $(e, e'K)$. The decay of the hyper-Pb would be detected via its fission branch, which should exhibit delayed fission if the above hypothesis is correct. The kaons would be detected at forward angles in the Hall C spectrometers. The target would be placed nearly parallel to the beam so that the fission fragments could exit the target into a pair of low-pressure MWPCs. Fast timing (via scintillators for the kaons and via the MWPCs for the fission fragments) should enable measurement of lifetimes down to 200ps. The time structure of the CEBAF beam (1.67ps bunch width and ~2ns bunch spacing in Hall C) would provide the time-zero information.

There are concerns about background from the electron beam and intense photofission contributions which, although prompt, might mask the desired signal. The PAC suggests investigating performing this experiment using (π, K) reactions, *e.g.* at the BNL AGS.

Letter-of-Intent: LOI-94-102
Spokespersons: S. Danagoulian
Title: Studies of Backward Proton Production Mechanisms in the $^2\text{H}(e, e'\bar{p})n$ Reaction at Moderate Momentum Transfer

The proposed experiment would study off-shell and relativistic effects, final state interactions, the influence of the Pauli principle and meson exchange currents under kinematical conditions forbidden for free protons. However, the proposal is not well focused, and the capability to separate the various physical phenomena is not substantiated by the calculations. It is not at all clear how the different structure functions should be separated in practice. In view of the large number of previously approved experiments on photo- and electrodisintegration of the deuteron, the committee is of the opinion that the present letter-of-intent is not of sufficient interest to encourage additional experimental activity.

Letter-of-Intent: LOI-94-103
Spokespersons: T. Saito
Title: High Resolution Electroproduction of Light Hypernuclei

This letter basically represents an extension of CEBAF PR-94-107 to include ^4He as a target. The septum technique proposed for the Hall A spectrometers is interesting but the collaboration needs to assess the physics priorities for the various targets proposed in this program so that experiments can be performed in the optimal way.

Letter-of-Intent: LOI-94-104
Spokespersons: D.C. Doughty and M.V. Kossov
Title: Electroproduction of K^* Mesons

The proposers discuss a measurement of the electroproduction of the K^* (accompanied by a hyperon) off a proton target at a beam energy of 4 GeV. They hope to extract the electromagnetic $\gamma^* K^* K$ transition form factor by extrapolating the t -dependence of the K^* electroproduction amplitude to the kaon pole, a very challenging undertaking, and to determine the K^* polarization from the angular distribution of its decay into $K\pi$.

This LOI requires no additional beam time as it can be done within the allocated time for PR-93-022 and of the N^* collaboration. We encourage the experimenters to proceed.

Letter-of-Intent: LOI-94-105
Spokespersons: P. Welch, C. Keppel, B. Norman
Title: Threshold ϕ Photoproduction and the Origin of OZI Violations

This LOI represents one physics justification for a laser backscattering facility in Hall B. Threshold photoproduction of the phi meson would be studied using a nearly 100% polarized photon beam in order to study the mechanism of OZI rule violation and/or strangeness content of the proton. Measurement of the density matrix elements would enable separation of diffractive and non-diffractive components of the amplitude. Further work is necessary to demonstrate how the physics would be extracted for these diffractive and non-diffractive processes. A well-focused investigation of this physics could represent a component of a comprehensive laser backscattering program.

Letter-of-Intent: LOI-94-106
Spokespersons: R. A. Magahiz
Title: Measurement of K^0 Electroproduction

This letter-of-intent describes the possibility of studying the $p(e, e' K^0) \Sigma^+$ reaction in the CLAS. It appears that the central motivation is to obtain the basic electromagnetic couplings to the $NK^0 \Sigma^+$ channel. An L/T separation for the reaction would be made as a means to isolate s - and t -channel processes. Excited states of the nucleon dominate the s -channel processes while exchange of the K^0 dominate the t -channel. Charge and flavor conservation permit only a Σ^+ in the final state unlike the complementary $p(e, e' K^+) \Lambda(\Sigma^0)$ reaction where the Λ^0 and Σ^0 must be separated. Thus, this reaction is very selective. The PAC considers the extraction of the K^0 form factor to be a challenging problem. Simulations indicate that detection of K^0 's by 2π decay are feasible. This experiment, which requires no new beam time or special constraints on the trigger, appears to be a interesting addition to the kaon electroproduction program.

Letter-of-Intent: LOI-94-107, Hall B
Spokespersons: C. Hyde-Wright & L. Weinstein
Title: A Search for Very Light Gluinos

This letter aims to search for the gluino in a narrow, still controversial, mass interval around 1 GeV. Glueballino pairs produced by virtual photons would be identified in CLAS by their long lifetime and hadronic decay products.

The PAC recognizes the interest of this fundamental physics issue but is strongly concerned with the real possibility to make unambiguous identification of two-three meson decay events in a high background region. The PAC suggests that the aim of this gluino search in the low mass region would be better pursued using higher energy beams and detectors having selective triggers to explore a more extended region of the controversial mass-lifetime window.

Letter-of-Intent: LOI-94-108 (Originally included as an extension to E-94-015)
Spokespersons: R. A. Miskimen & K. Wang
Title: Experimental Study of Chiral Anomaly with Polarized Photons

It is planned to extend the approved experiment E-94-015 with linearly polarized tagged photons in the CLAS in Hall B. The experiment would use the proposed Compton Backscattering Facility (CBF) and 6 GeV beam. The addition of linearly polarized photons should allow the possibility of choosing both π^+ and π^0 as the exchanged mesons by separating the t -channel OPE contribution from diffractive and other processes. The PAC endorses the physics case and recommends that the collaboration produce a full proposal in conjunction with the development of the physics case for the CBF.